**Managing bighorn sheep using data VS opinions**

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Readers of Alberta Outdoorsmen expect to see fact-based reports. Recent writings by Mark Boyce, however, provide a biased and selective presentation of my research and of bighorn sheep management in Alberta. Bighorn sheep are particularly prone to hunter-induced evolution under an unlimited-entry system, because rams with fast-growing horns become legal years before large horns provide a mating advantage. Much evidence supporting that statement is available in the scientific literature, unlike any of Mark Boyce’s musings on this subject. Here I examine his attack on the science-based recommendation by Fish & Wildlife biologists that sheep hunting regulations should be changed to stop the decline in horn size. To check facts, please see the Draft Sheep Management Plan at <http://esrd.alberta.ca/fish-wildlife/wildlife-management/documents/BighornSheepMgmtPlan-Draft-Jun25-2015A.pdf> Presentations by myself and Dave Coltman to the Alberta Wildlife Society are at https://www.researchgate.net/publication/301300449\_Presentation\_to\_Alberta\_Wildlife\_Society\_Drumheller\_March\_2016

Without presenting any data, Mark Boyce claims that genetic rescue from National Parks will swamp any hunter-induced selection. That is not happening: rams shot near and far from the parks show similar declines in horn size. From Cadomin north, however, horn size has not declined over time. Genetic rescue may be happening there, because there is no spike in harvest in the last 10 days of the season. That spike is strong in most of the province. Genetic rescue can only work if rams exiting national parks can breed. Many would-be genetic rescuers that exit the parks in late October get shot. To allow genetic rescue, the season should end 10 days earlier.





Ram harvest in Sheep Management Areas 4B (top) and 7-8 (bottom), from the draft sheep management plan. The peak in week 9 in 4B is typical of most sheep management areas, and likely includes rams exiting the National Parks looking for breeding opportunities. That peak is absent in sheep management areas 7 and 8, where ram horn size has not decreased over time.

Mark Boyce makes a remarkable series of misstatements in his latest article. The most egregious is the claim that harvest at Ram Mountain was only 8% of ‘mature’ rams. Rams cannot be harvested unless their horns make them legal! It is bizarre to calculate harvest rate including animals that cannot be shot, yet this misleading argument is frequently parroted by those who refuse to even consider that selective hunting may select. To understand selective pressures on large rams, harvest must be measured as a proportion of rams that can be legally harvested. Harvest of legal rams on Ram Mountain when it was managed under 4/5-curl was 40%. A ram legal by age 4 had about a 9% chance of surviving the 4 hunting seasons and 3 years of natural mortality before the rut at age 7, the age at which large-horned rams have high mating success. **A 91% mortality rate is a strong negative selective pressure, especially compared to the 70% natural survival over the same time for sub-legal rams.** The inevitable consequence is that rams with small horns live longer and father more lambs. This is not rocket science, it is exactly the opposite of what farmers do with livestock.

I was puzzled to read the claim that the non-trophy hunt on Ram Mountain ended when Bill Wishart retired in 1987. There has not been a non-trophy hunt on Ram Mountain since at least 1971 and the experimental removal ended in 1981.

Another curious contention is the claim that the bighorn population in Alberta increased after Bill Wishart retired. Population survey data in the draft management plan say otherwise. **Numbers have increased only in the northern sheep management areas, where ram horn size has remained stable**. Remarkably, in the same article, Mark Boyce says that bighorn populations in Alberta have been stable for over 30 years. The high ram harvest in the ‘golden age’ in Alberta has little to do with Wishart’s employment status and more to do with a tripling of sheep hunters, from about 1000 licenses sold in 1974 to about 3200 in 1984-1986. During that time, the estimated provincial bighorn population increased. Recently, the harvest has ‘stabilized’ despite another increase in the number of licenses, but the proportion of rams aged 4 or 5 years in the harvest continues to decline, suggesting continuing decreases in horn growth. At the Alberta Wildlife Society meeting in March, Mark Boyce presented a graph showing no decline in horn size in harvested rams over time. He conveniently ignored changes in the age of harvested rams: those shot in recent years have horns of length comparable to those shot 30 years ago, but are on average one year older. Ram horn size increases with age, the claim of no change in horn length flies in the face of the evidence. The number of resident trophy sheep licenses has increased by nearly 40% over the past 10 years. The success rate has declined, to about 4-5%.

Why are Alberta bighorns becoming littlehorns? **Many factors affect horn growth: population density, weather, habitat quality**. In a bait-and-switch ploy, I am accused of ignoring these factors when I point out that **genetic effects** are also important. **Publications from my research group that deal with evolutionary changes also account for weather and density**. Mark Boyce uses data from Ram Mountain, where the number of ewes tripled, to claim that the decline in horn size in Alberta is due to ‘too many ewes’. Higher ewe harvests may well improve ram horn growth, but why are horns smaller now than 30 years ago given that population size has changed little? In BC, Rocky Mountain bighorns are hunted under a full-curl rule and there are no ewe harvests: why has their horn size not declined? **Why are the largest rams in Alberta shot near the National Parks, where there is no ewe harvest? Why has ram horn size not declined in northern areas in Alberta where population estimates suggest an increase in density over the past 30 years?**  Why are Stone’s sheep horns shrinking in the Peace area of northern BC, with high trophy harvest rates, and not in the Skeena, with low harvest rates? There is no ewe sport harvest of Stone’s sheep in either area. The statement that the Alberta bighorn population increased after 1987 is unfounded, nor is there any clear evidence that it decreased when ewe harvest was higher: check the area-specific population estimates in the draft management plan. I am not against increasing the ewe harvest, provided we can keep a good handle on population numbers. During years of high cougar predation, increased ewe mortality leads to very rapid declines in population size. High ewe harvest in the absence of regular, reliable population estimates is very risky.

Mark Boyce’s selective presentation of Ram Mountain data suggests an apocalyptic scenario under full curl. Once again, that is misleading. Harvest indeed tanked after the switch to full curl, but regulations changed as the Ram Mountain population declined by over 70%, and the combination of high density and artificial selection led to a 25% decline in horn size: there were hardly any legal rams under any definition! Not exactly a typical population to use as a gauge for all of Alberta. In Sheep Management Area 1, there has been **at** **most a 25% (not Boyce’s prophesized 80%) decline in ram harvest after switching from 4/5 to full-curl.**



From the draft Alberta sheep management plan: ram harvests in Sheep Management Area 1 declined after a major die-off in 1983. A few years after the switch to full-curl they were 2-4 fewer than in the last 12 years under 4/5-curl. Obviously something unusual happened in 1992!

Will harvest decline under full-curl? Yes, perhaps by 20-30% as is necessary to avoid hunter-induced selection. BC has been hunting Rocky Mountain bighorns under a full-curl rule for decades. Alberta is the only jurisdiction in North America with general bighorn sheep hunting seasons and a 4/5 curl restriction. **Nearly all other jurisdictions on the continent have stricter hunting regimes and lower harvest rates**. Intense selective harvest is one of the reasons causing ram horns to shrink. Like it or not, that is what the data say.